PATENT SPECIFICATION (11) 1278099

1278099

DRAWINGS ATTACHED

(21) Application No. 46346/69 (22) Filed 19 Sept. 1969

(23) Complete Specification filed 18 Sept. 1970

(45) Complete Specification published 14 June 1972

(51) International Classification B05C 11/02

(52) Index at acceptance D1L 23G

(72) Inventor EDMUND FREDERIC HALL

(54) COATING FILM MATERIAL

(71) We, TRANSPARENT PAPER LIMITED, a British Company, of Bridge Hall Mills, Heap Bridge, Bury, Lancashire, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the coating of film material and is particularly concerned with the operation of smoothing rollers for smoothing a layer of coating liquid on a film.

In the coating of films of regenerated cellulose and other materials, such as are used for packaging purposes, with a coating liquid comprising a solution or dispersion of moisture-proofing and other compositions, it is conventional to immerse the advancing film through a bath of the coating liquid and to remove excess liquid by passing the film after it emerges from the bath between a pair of closely spaced parallel metering rollers which are designed to leave a required amount of the liquid on the film.

Before drying this applied coating, it is desirable to smooth out longitudinal striations which appear on the film due to the use of these metering rollers. A marked improvement in the striations is normally effected by contacting the rising film on each side alternately with the surface of counter-rotating smoothing rollers, of which there are usually two on each side.

By the term "counter-rotating" it is meant that the surface of the roller which lightly contacts the film is made to travel in the opposite direction to that of the film which generally travels vertically upward, the surface speed of the roller being generally lower than the speed of the advancing film.

It seems to be generally understood that one smoothing roller per side is insufficient, and in one difficult case it has even been proposed that a minimum of five rollers per side be employed. In general, however, two rollers per side are used.

Broadly, the present invention concerns improvements in the smoothness of these coatings obtainable by imparting to the smoothing rollers continuous movement to and fro in relation to the film.

Accordingly, one aspect of the present invention provides a method of coating a film with a coating liquid, wherein one or both sides of a travelling film is or are coated with the coating liquid, the thickness of which is metered to a desired value, and wherein the or each coated side of the film is contacted with at least two smoothing rollers each of which rotates in a sense such that the surface of the roller in contact with the film travels in the opposite direction to the direction of travel of the film, and at least one of which is continuously moved to and fro in relation to the film.

According to another aspect of the present invention there is provided apparatus for coating a film with a coating liquid comprising means for applying the coating liquid to one or both sides of a travelling film, means for metering the thickness of the applied coating liquid to a desired value, at least two smoothing rollers mounted to contact the or each coated side of the film, means for rotating the rollers such that the surface of a roller in contact with the film travels in the opposite direction to the direction of travel of the film, and means for continuously moving at least one roller to and fro in relation to the film.

In one embodiment of the invention the or each roller is both reciprocated in its axial direction transverse to the direction of travel of the film and caused to vibrate in other than the axial direction, e.g. in the vertical or horizontal direction. However, the or each roller may be only reciprocated or only vibrated.

Preferably, if more than one roller is continuously moved the rollers are reciprocated so that they are out of phase with one another. Preferably at least three smoothing rollers are employed for each coated side of the film.

It is believed that the smoothing action of the previously proposed smoothing rollers is achieved mainly as follows: consider a very

[Price 25p]

narrow relatively thick stripe of coating liquid rising from the metering rollers. When this meets the low speed counter-rotating surface of the smoothing roller, a small dam or puddle of coating liquid will accumulate and will naturally assume a width greater than the width of the original stripe. The counter-rotating roller, supplied from this puddle, takes a portion of the coating liquid round on its surface and re-applies it to the surface of the film. The very action of picking up and laying down the coating liquid, as well as the formation of the wider puddle, results in the stripe of coating liquid being widened out and thinned. The action is of course then taken a further stage when the second smoothing roller is encountered.

It is this widening out and thinning of the striations which results in a smoother coating, and the initial improvement imparted by the present reciprocating movements is believed to be due to a sideways thrust imparted to the puddle, thus increasing its effective width and reducing its thickness still further. A secondary effect is that the then largely flattened stripe of coating liquid carried on the surface of the roller is given a sinuous path when transferred to the rising film and the next roller in line is not therefore called upon to deal with a simple vertical stripe. This angular attack of the second roller can be enhanced by arranging the reciprocations of the second roller to move at the same speed but out of phase with those of the first. The effect of this angular attack is still further to spread the surface irregularities, with consequent improvement of smoothness.

If, however, the horizontal movements of the two smoothing rollers, which are vertically aligned, are arranged in a completely opposite sense, cyclic variations in effect occur. This is due to the fact that the reciprocating movements must, for mechanical reasons, be largely or completely harmonic, so that at the mid-position of the two rollers the sideways smearing effect is at a maximum, whilst near the end-positions where the motions are reversed, there is little or no sideways-smear effect. For this reason, a preferred arrangement is to employ at least three smoothing rollers on each side of the film, each reciprocating at similar speeds and with similar amplitudes but out of phase insofar that at any given moment, one of the rollers is always at or near its maximum horizontal speed and effectiveness.

In order to obviate any tendency of the smoothing rollers to cause undesired horizontal displacement of the film itself, in spite of the fact that the metering rollers grip the film to some extent and in spite of the tension in the film at this point, it may be arranged that the smoothing rollers on one side of the film be phased to move in an opposite horizontal sense to that of the rollers on the other side.

In order further to describe this invention reference will now be made to the accompanying drawings which illustrate diagrammatically and by way of example an embodiment thereof and in which:—

Fig. 1 is a schematic side view of apparatus for coating film material according to the invention, a support structure for the rollers being omitted for the sake of clarity,

Fig. 2 is a schematic front view of the apparatus shown in Fig. 1, showing a support structure in outline,

Figs. 3 and 4 are end views of a smoothing roller forming part of the apparatus shown in Figs. 1 and 2, and illustrate vibration of the axis of a roller in vertical and horizontal planes respectively.

Referring now to the Figs., an apparatus for coating regenerated cellulose comprises a coating bath 6 through which a film 1 of regenerated cellulose is led in the direction shown by the arrow A, and coated. Metering rollers 4 are mounted above the bath 6 to receive the coated film after it leaves the bath and to control the thickness of the coating liquid on both sides of the film. Above the metering rollers and below a drying chamber 5 for drying the coating liquid are arranged, on a support structure 2, six smoothing rollers 3, three on each side, staggered in the usual manner. They are counter-rotated such that their surface speed is less than one-half the speed of the advancing film.

The diameter of the rollers 3 which have smooth surfaces is 50 mm. and the vertical distance between their centres on each of the sides of the film is 125 mm.. The rollers on one side are at a 62.5 mm. vertical distance from their fellows on the other side, so that the vertical distance between the bottom and top rollers of the six is 312.5 mm.. The rollers are reciprocated axially, with an amplitude of 20 mm., at a speed of one complete return movement per 2 revolutions, in such a way that the middle roller of one set of three begins its movement when the bottom one has completed about one-third of its total movement, and the top roller of the set begins its movement when the middle one has completed about one-third of its total movement. This axial movement of each of the three smoothing rollers on one side of the film is easily effected since the three relevant shafts are vertically aligned. A vertical camshaft is arranged in a manner known *per se* for reciprocation of a body, to carry three single- or plural-lobed cams each of which bears on the end of a smoothing-roller shaft, or on a cam-follower which likewise bears on the shaft. The action of the cams is to push the shaft and thus its roller in one direction, the return movement being effected by means of a suitable spring in compression, in a manner known *per se* for producing return movement. The drive for the rotation of the smoothing rollers is by straight-

cut gears of known kind and of face width sufficient to accommodate the axial movement. The three rollers on the opposite side of the film are similarly reciprocated but in the opposite sense. The machine is run so that the film moves through it at a speed of 200 m./min. and the reverse rotation of the smoothing rollers is at the rate of 191 rpm.. The rate of reciprocation, at one complete movement per two revs, is therefore 95.5 per min. which is easily attainable with light, hollow rollers.

If desired, the delay in time between the effect of any adjacent pair of rollers on one side, which with the figures given amounts however to less than 0.04 secs., may also be taken into account in equally spacing the phasing of the three rollers, but this has not been found to be necessary.

Whilst the described embodiment refers to an axial reciprocating motion with an amplitude of 20 mm. and a frequency of about 80 cycles/minute, it is clear that the amplitude and frequency of the reciprocating motion can be varied widely. In particular the amplitude may be materially reduced and the frequency substantially increased until the movement of the rollers can best be described as a vibration. Further, when this speed of cycling is reached it is no longer necessary, although still desirable, that the movement be axial; a vibration in other planes gives useful improvements in the smoothness of the coating, presumably due to physical disturbance of the puddle of coating liquid previously mentioned. Vibration other than axial is diagrammatically illustrated in Figs. 3 and 4 by the double-headed arrows B and C, by way of example only.

Although the described embodiment refers to coating the film by passing it through a coating bath and then metering by means of metering rollers, it is clear that other methods of obtaining a metered coating may be used. For example, a coating of liquid may be sprayed onto the film, the spraying operation being controlled to give a coating of a desired thickness. Such a controlled spraying operation amounts to metering the coating before it is applied.

WHAT WE CLAIM IS:—

1. A method of coating a film with a coating liquid, wherein one or both sides of a travelling film is or are coated with the coating liquid, the thickness of which is metered to a desired value, and wherein the or each coated side of the film is contacted with at least two smoothing rollers each of which rotates in a sense such that the surface of the roller in contact with the film travels in the opposite direction to the direction of travel of the film, and at least one of which is continuously moved to and fro in relation to the film.

2. A method of coating a film with a coating liquid as claimed in Claim 1, wherein metering is carried out subsequent to coating.

3. A method of coating a film with a coating liquid as claimed in Claim 1 or 2, wherein each roller is continuously moved to and fro in relation to the film.

4. A method of coating a film with a coating liquid, as claimed in any preceding claim, wherein the continuous movement of the or each roller to and fro comprises reciprocation in an axial direction.

5. A method of coating a film with a coating liquid, as claimed in Claim 4, wherein the rollers are reciprocated so that they are out of phase with one another.

6. A method of coating a film with a coating liquid, as claimed in Claim 5, wherein both sides of the film are coated and the rollers on one side of the film are phased to move in an opposite horizontal sense to that of the rollers on the other side.

7. A method of coating a film with a coating liquid, as claimed in any preceding claim, wherein at least three smoothing rollers are employed for each coated side of the film.

8. A method of coating a film with a coating liquid, as claimed in any preceding claim, wherein the continuous movement of the or each roller to and fro comprises vibration in the axial direction.

9. A method of coating a film with a coating liquid, as claimed in any preceding claim wherein the continuous movement of the or each roller to and fro comprises vibration in other than the axial direction.

10. Apparatus for coating a film with a coating liquid comprising means for applying the coating liquid to one or both sides of a travelling film, means for metering the thickness of the applied coating liquid to a desired value, at least two smoothing rollers mounted to contact the or each coated side of the film, means for rotating the rollers such that the surface of a roller in contact with the film travels in the opposite direction to the direction or travel of the film, and means for continuously moving at least one roller to and fro in relation to the film.

11. Apparatus as claimed in Claim 10, comprising means for continuously moving each roller to and fro in relation to the film.

12. Apparatus as claimed in Claim 10 or 11, wherein the means for continuously moving the or each roller to and fro comprises means for reciprocating the or each roller in its axial direction.

13. Apparatus as claimed in any of Claims 10 to 12, wherein the means for continuously moving the or each roller to and fro comprises means for vibrating the or each roller in its axial direction.

14. Apparatus as claimed in any of Claims 10 to 13, wherein the means for continuously moving the or each roller to and fro comprises means for vibrating the or each roller in other than its axial direction.

15. A method of coating a film with a coating liquid substantially as hereinbefore des-

cribed with reference to the accompanying drawings.

16. Apparatus for coating a film with a coating liquid substantially as hereinbefore described with reference to the accompanying drawings.

TREGEAR, THIEMANN & BLEACH,
Chartered Patent Agents,
Melbourne House,
Aldwych,
London, W.C.2.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1972.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1278099 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG.1

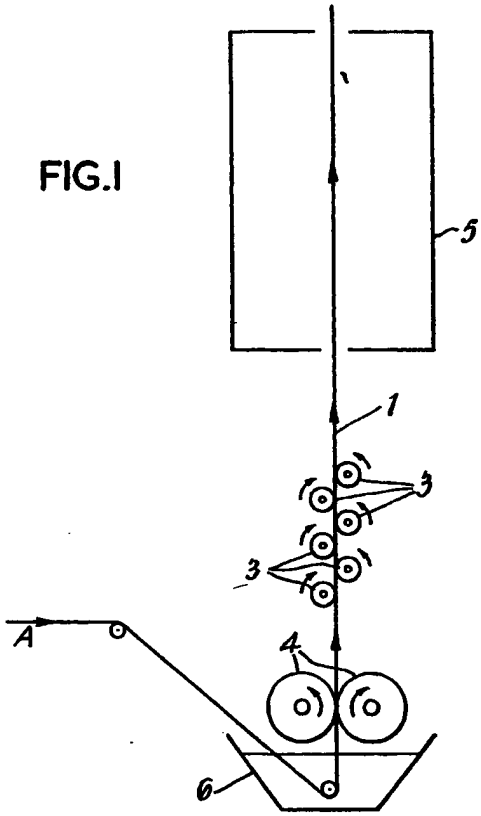

FIG.3

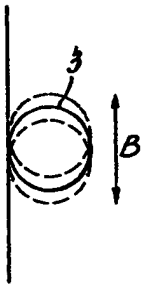

FIG.4

1278099 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

FIG.2